WINTERING BATS OF THE UPPER SNAKE RIVER PLAIN: OCCURRENCE IN LAVA-TUBE CAVES

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ABSTRACT.—Distribution and habitat selection of hibernating bats at the Idaho National Engineering Laboratory (INEL) and adjacent area are reported. Exploration of over 30 lava-tube caves revealed that two species, *Myotis leibii* and *Plecotus townsendii*, hibernate in the upper Snake River Plain. Five species, *M. lucifugus*, *M. evotis*, *Eptesicus fuscus*, *Lasionycteris noctivagans*, and *Lasiurus cinereus* are considered migratory. *Myotis leibii* and *P. townsendii* hibernate throughout much of the area, occasionally in mixed-species groups. *Myotis leibii* uses the dark and protected regions of the cave, usually wedged into tiny pockets and crevices near or at the highest portion of the ceiling. Individuals of *P. townsendii* may be found at any height or depth in the cave. Temperature appears to be the primary limiting factor in habitat selection. *Myotis leibii* was found in significantly cooler air temperatures than *P. townsendii*. Neither species tolerated continuous temperatures below 1.5 C. Relative humidity does not seem to be a significant factor in the distribution or habitat selection of the two species in lava-tube caves.

Field studies in the northern Rocky Mountains have provided fairly comprehensive records of bats for discontinuous geographic locations (Fenton et al. 1983, Genter 1985b, Negus and Findley 1959, Swenson and Shanks 1979). However, information regarding wintering species and their ecological requirements in the region is minimal.

An intensive survey of potential bat hibernacula, population size, and species composition was conducted during the winter of 1984–85 at the Idaho National Engineering Laboratory (INEL). Additionally, distribution and microhabitat preference of each species were investigated.

STUDY AREA AND METHODS

The INEL is on the upper Snake River Plain near the southeastern ends of the Lemhi and Lost River Mountain ranges. The elevation of this predominantly level plain averages 1,525 m. Two volcanic buttes near the southern boundary rise to 1,993 m. The vegetation is typical of the cold-desert in the Great Basin region. Recent basalt flows cover the southwestern portion of the site, extending throughout the adjacent Craters of the Moon National Monument (CROM). The northeastern area is a complex mixture of volcanic deposition, glacial debris, and Lake Terreton Playas. All caves studied were lava tubes restricted to the basalt flows (Fig. 1).

Temperatures were recorded with a Taylor bulb thermometer. Relative humidity was determined using a sling psychrometer (Taylor Instrument Co., Rochester, New York). Observations were made from 12 December 1984 to 27 January 1985, between 1000 and 1600 MST. Temperature and relative humidity were measured within each cave at the entrance and throughout the cave at approximately 15 m intervals regardless of the presence of bats and at sites where bats were hibernating. Voucher specimens are in the Zoological Museum of the University of Montana and in the vertebrate collection of the Radiological and Environmental Sciences Laboratory at the INEL.

RESULTS

Hibernating populations of *Myotis leibii* and *Plecotus townsendii* were found. Nine of the 31 caves investigated contained a total of 185 *P. townsendii* and 78 *M. leibii* (Table 1). Successive counts in each of several caves revealed that the number of individuals of each species remained constant within any cave. *Plecotus townsendii* were observed to move about within caves, but *M. leibii* apparently did not. Temperature within caves containing

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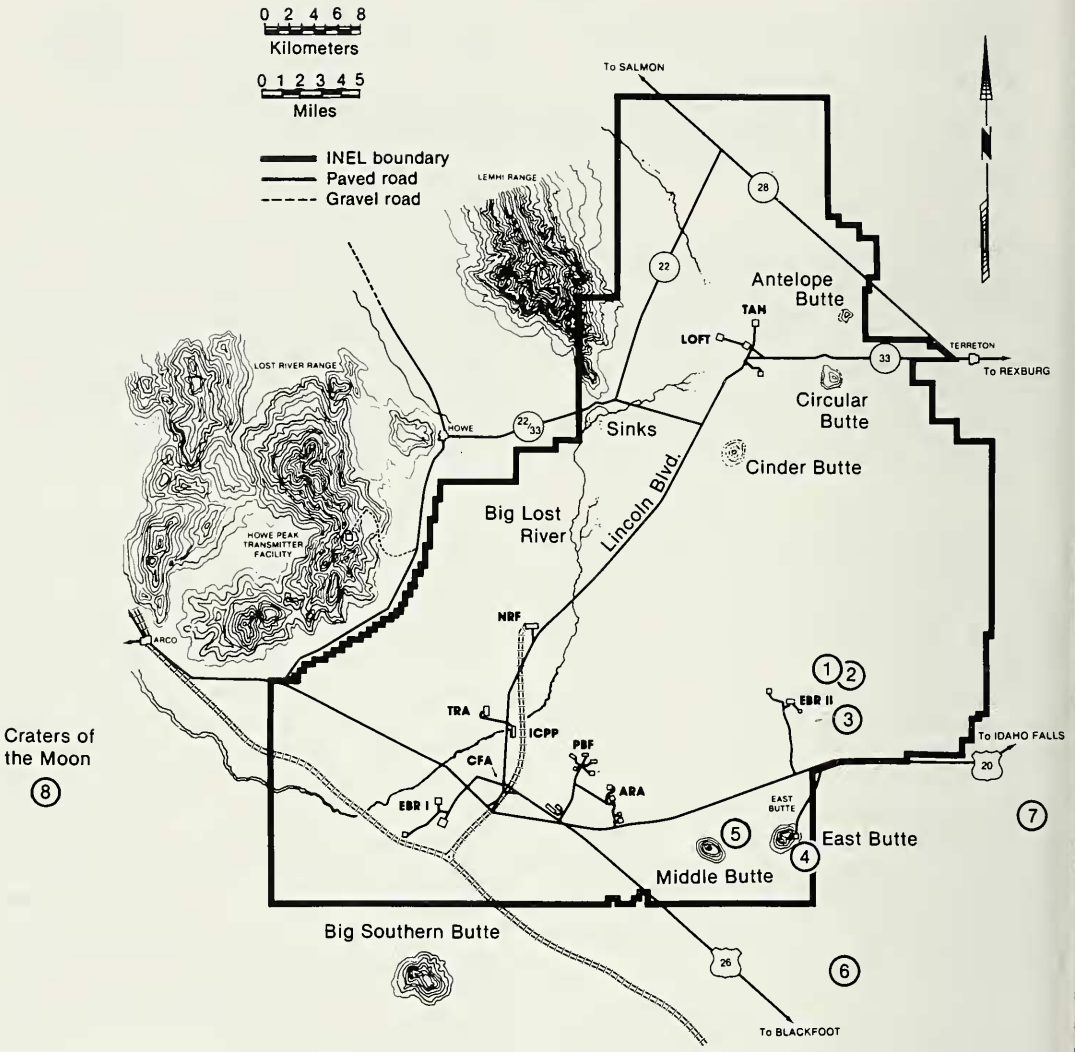

Fig. 1. Bat hibernacula of the INEL basalt flow. 1, EBR II Cave 3. 2, EBR II Cave 4. 3, Rattlesnake Caves. 4, Moonshiner's Cave. 5, Middle Butte Cave. 6, Catscat Cave. 7, Sixteen Mile Cave. 8, Arco Tunnel.

bats ranged from −1.2 to 7.0 C. Temperatures of hibernacula were more limited. *Myotis leibii* was found in air temperatures from 1.5 to 5.5 C ($X = 2.4 \pm 0.82$). *Plecotus townsendii* inhabited significantly warmer regions of the caves ($t = 2.91$, $p < .05$), with temperatures ranging from 2.2 to 7.0 C ($X = 4.8 \pm 0.96$; see Table 1). Caves containing only *M. leibii* were colder overall than those containing only *P. townsendii* ($X = 1.8 \pm 1.38$ and $X = 4.7 \pm 0.51$, respectively; $t = 2.49$, $p < .05$). *Myotis leibii* would commonly be found in the warmer regions of cold caves (subfreezing), whereas *P. townsendii* was never found in caves with extensive areas of subfreezing temperatures.

Relative humidity varied widely among caves (< 43% to 100%). Hibernacula humidity ranged from 65% to 80% for *M. leibii* and from 68% to 100% for *P. townsendii* but was not significantly different between species ($t = 1.22$; $p > .1$).

Each species used different types of roosts within the caves. *Myotis leibii* was closely associated with textured and rimatious substrates. Eighty percent wedged themselves in crevices facing outward. All but 2 of the remaining 15 bats were in hollow depressions. In contrast, *P. townsendii* hung in exposed, open areas of the cave. *M. leibii* hibernated with the ventrum against the cave surface.

TABLE 1. Mean temperature and relative humidity with standard deviation for each cave. Number of each species counted with mean temperature for their roost sites.

Cave	Temperature (C)	Relative Humidity (%)	*Myotis leibii*	*Plecotus townsendii*
Arco Tunnel	0.9 ± 1.12	69.7 ± 5.3	3 (1.5)	0 (–)
Catscat Cave	2.0 ± 0.89	67.4 ± 11.3	4 (2.1)	0 (–)
Rattlesnake Cave (East Tunnel)	2.4 ± 0.82	78.4 ± 9.8	4 (2.4)	0 (–)
Rattlesnake Cave	3.9 ± 1.51	57.1 ± 12.9	41 (4.1)	132 (5.0)
Sixteen Mile Cave	4.2 ± 1.13	84.5 ± 4.7	16 (4.0)	8 (4.4)
Middle Butte Cave	4.7 ± 1.36	62.3 ± 14.7	9 (4.1)	15 (5.5)
EBR II - Cave 4	4.4 ± 0.59	80.3 ± 6.7	0 (–)	7 (4.7)
EBR II - Cave 3	4.8 ± 0.24	85.5 ± 7.5	0 (–)	11 (5.0)
Moonshiner's Cave	4.7 ± 0.49	100.0 ± 0.0	0 (–)	12 (4.8)

Plecotus townsendii hung from the substrate. In approximately 94% of the *P. townsendii* both ears were curled in a ram's horn fashion. The other 9 individuals had either one or both ears erect. All the latter were found in warmer (above 5 C) regions of the cave. Four bats with erect ears were fully aroused and occasionally took flight, whereas bats with curled ears never did so.

DISCUSSION

The length of time that a bat can hibernate has been estimated for several species (Studier and O'Farrell 1976, Hill and Smith 1984). In general, larger bats are capable of longer periods of hibernation and may undergo more frequent episodes of activity. Individuals of *M. leibii* were found in hibernacula with low air temperatures that varied little temporally or spatially. The narrow range of temperatures occupied illustrates habitat selection reflecting their need to conserve energy (McNab 1969, O'Farrell et al. 1971, Studier and O'Farrell 1976). Higher ambient temperatures induce a higher basal metabolic rate, and the ranges of temperatures chosen by bats keep them within species-specific energy budgets necessary for prolonged hibernation (Davis 1970, Hill and Smith 1984). The tendency of *M. leibii* to use crevices and sheltered areas likely subjected them to less environmental fluctuation.

Plecotus townsendii was the most abundant species found hibernating in the area. This may reflect a higher population density or lack of suitable wintering habitat for other species. *Plecotus townsendii* hangs from ceilings at varying heights and occupies nearly all depths within the caves. I did not observe them close to cave openings as did Twente (1955, 1960). Nearly all individuals of *P. townsendii* hibernated with their ears in ram's horn fashion, which may serve to decrease heat loss by radiation.

The apparent absence of other cavernous species of bats hibernating is not readily explained. Summer field studies indicated the few *M. lucifugus* at the INEL were closely associated with buildings. Nine individuals of *M. leibii* were recovered from within and around buildings late in September, suggesting these structures serve as hibernacula. *Eptesicus* left the caves used as summer roosts in late September. As is the case over much of its range, little is known on the wintering habits of *M. evotis*. Likely both *M. lucifugus* and *E. fuscus* winter in southeastern Idaho; these species commonly hibernate near their summer roost areas (Barbour and Davis 1969). Their absence in this study suggests that neither species finds lava-tube caves suitable for hibernation.

More extensive surveys are needed to gain a better understanding of the habitat selection and ecology of wintering bats in the northern Great Plains. Investigating a greater diversity of cavernous structures over a wider physiographic region should prove fruitful. The wintering ecology of bats is an important aspect of their life history and one that deserves further study.

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